STATE OF WASHINGTON
DEPARTMENT OF EDUCATION
Bulletin No. 21, Supplement to State Manual No. 3

A Manual of Agriculture

FOR THE

EIGHTH GRADE

BY

A. M. RICHARDSON,
County Agriculturist of Douglas County

PUBLISHED BY
SUPERINTENDENT OF PUBLIC INSTRUCTION
OLYMPIA, WASH.
1914

OLYMPIA
FRANK M. LAMBORN PUBLIC PRINTER
1914

STATE OF WASHINGTON
DEPARTMENT OF EDUCATION

Bulletin No. 21, Supplement to State Manual No. 3

A Manual of Agriculture

FOR THE

EIGHTH GRADE

BY

A. M. RICHARDSON,
County Agriculturist of Douglas County

PUBLISHED BY
SUPERINTENDENT OF PUBLIC INSTRUCTION
OLYMPIA, WASH.
1914

OLYMPIA
FRANK M. LAMBORN PUBLIC PRINTER
1914

FOREWORD.

The widespread interest in the teaching of agriculture and the requirement of the State Board of Education that pupils taking the eighth grade examinations must be examined either in agriculture, home economics or manual training, make timely the publication of this Manual of Agriculture for the Eighth Grade. It is designed to supplement the regular State Manual, and will form the basis for the eighth grade examination in agriculture. I feel that we have been fortunate in the authorship of the Manual. Mr. Richardson has been until recently instructor in agriculture in the Snohomish public schools, and has brought to his writing the knowledge acquired not only from a thorough study of the science, but also from experience in presenting it to boys and girls.

The aim in the preparation of the Manual has been to aid teachers, particularly teachers in rural schools, who have had no training in agriculture and who have no laboratory equipment at hand, in the task of presenting the elementary phases of agriculture in a way that will accomplish valuable results. I feel from an examination of the material offered, that the aim has been well met and that the exercises will prove not only suggestive, but actually usable by the teachers of the state.

The point of view chosen for the Manual was that of experiment. While there are many good texts in agriculture on the market, in most cases their treatment of the science is academic. The endeavor here has been not to study agriculture through a text book, though supplementary literature will be found helpful, but by drawing on the pupil's previous experience and by directing and quickening his powers of observation, to show him the identity of the theoretical and practical aspects of agriculture, and to encourage a wholesome interest in his own surroundings. I believe that the point of view is correct from the standpoints both of science and pedagogy. The Manual may therefore be used either with or without texts in the hands of the pupils.

MRS. JOSEPHINE CORLISS PRESTON,
Superintendent of Public Instruction,
Olympia, Washington.

February 1, 1914.

PREFACE.

No attempt has been made to make an exhaustive list of exercises. It would be an easy matter to devote all the time allotted to the study of agriculture in the eighth grade to any phase of the subject. Exercises are included in practically every phase of this great subject. Teachers are urged to lay special emphasis upon that type of farming that is of most importance in their locality. All the exercises included are easy to work out and illustrate some principle necessary in the study of agriculture. No apparatus is called for that cannot be easily procured at little or no cost. In any good text book on agriculture the teacher will find ample material for additional exercises if they care for extra ones along any particular line.

In the back of the book six blank pages have been left in which the teacher may insert additional exercises. In case the county superintendent or county agriculturist desires to add exercises so as to amplify the work for the agriculture of his county, they may be prepared on typewritten sheets about 5½x8½ and the teachers instructed to paste them in the back of the Manual.

The study of agriculture offers splendid opportunity for cooperation between the home and the school and every opportunity should be taken advantage of. For example in the testing of seeds; have the pupils test seeds for any patron of the school who may care to have his seeds tested. In the spring, when you start the hotbed, have it understood that you are going to start different kinds of plants for transplanting, and that the parents are welcome to them. If the pupils have gardens at school, let them take their produce home. Have the pupils ask their parents practical questions that come up in their study. This will not only get the parents interested in what the children are doing, but it will give added interest to the children to know that they are studying things that they will be able to use and that older people are concerned about.

Whenever possible to have school gardens, they will be found to be of great value, but they should be taken as a means to an end and not the end. Their value lies in the training and personal inspection that the teacher is able to give during the preparation of the ground; the sowing of the seed; and care up to the time school is out. After that they are seldom of any real value. They aid greatly in arousing interest. If every boy and girl could and would have a small garden at home, it would be better, because they could tend it during the summer, and have it where they could see it at all times. Most of these exercises have been tried out and used in the grade work of the Snohomish public schools. A few additional ones have been selected to make a more complete list, and to offer a somewhat larger field for selection by the teacher.

It is not expected that the exercises be used in just the order given. Most of them may be given at any time that is convenient.

The out-door work should be done during good weather. The teacher should read the bulletin clear through and then plan the order which will give the best results. When possible the exercises should be studied according to season. For instance, experiments such as Nos. 22, 31 and 46 can best be carried on in the fall, while Nos. 11, 17, 36-41 are for spring; some such as Nos. 7, 35 and 45 must be started in the fall. Exercise No. 21 may well be broken up into several parts according to the season, harvesting and marketing in the fall, planting and tilling in the spring. Most of the work on soils can be done either early in the fall or during the winter. The stock judging work had better be done in the fall while the weather is good.

The hotbed and cold frame work should be started in plenty of time to have the plants large enough for transplanting when the gardens are ready to be planted. The hotbeds and the gardens will probably take all the time that can be spared after settled weather comes in the spring, so it will be best to get as much of the other work done before as possible.

A full list of books on agriculture may be found in the forthcoming Library List for elementary schools, to be published by the State Department of Education.

Teachers should send to Ira D. Cardiff, director of the Washington Experiment Station, Pullman, for a list of State College Bulletins, from which they can choose such as will be of help to them, and to the secretary of agriculture, Washington, D. C., for a list of Farmers' Bulletins; a list of publications for free distribution; and for the monthly list of publications.

After you receive your lists, select the ones adapted to your needs, send for them and allow the pupils access to them.

"Potato Score Card" is the one in use at the Washington State College; the score cards on live stock have been taken from Bulletin number twenty-nine, Indiana Experiment Station.

Many teachers and others interested in the subject have been helpful in the preparation of these exercises, by way of suggestion. Credit is especially due C. A. Sprague of the State Department of Education; C. W. Hodge, superintendent of the Snohomish public schools; C. E. Flint, Bellingham, Washington, and Mrs. Lizzie Jones, county superintendent of Snohomish county.

A large number of text books on elementary agriculture and bulletins have been read with much profit, to which credit is due.

TABLE OF CONTENTS.

Exercise No. 1.

FORMATION OF SOILS.

Take the class out for a field trip. Point out as many of the soil forming agencies as you can that have been instrumental in the formation of the soils of your region.

If near the mountains you can show the work done by glaciers; if near a stream you can point out its work. Show how freezing and thawing have changed and are changing the soil. Point out how the wind helps to transport and mix soils; when snow drifts there is generally more or less soil mixed with it and when the snow melts the soil remains. This explains in part why one side of a hill is generally steeper than the other; the side away from the prevailing wind being steeper than the side from which the wind blows. Explain how the bacteria in the soil are constantly causing the decay of the organic matter in the soil forming humus which is essential to plant growth.

If not convenient to take the class out, this exercise may be illustrated by showing them pictures of the work of each agency which may be easily found.

Exercise No. 2.

COLLECTING SAMPLES OF SOIL.

Take the class out for a field trip. Collect samples of as many different types of soil as can be found in your locality. If you can't find samples of each of the following: loam, clay, sand, and humus, perhaps some of the boys will make a special effort to get them.

Dig down with a spade or shovel to a depth of one to two feet and get a sample of the subsoil underlying each type of soil. Place each sample in a glass jar or a widemouthed bottle. Cover to prevent drying out, and label carefully.

Exercise No. 3.

EXAMINATION OF SOIL SAMPLES.

Have the class note the difference in color of the different samples collected in Ex. No. 2; the fineness or coarseness of the soil particles by rubbing them between the fingers. They will find the clay has little if any grit when rubbed between the fingers; that the loam has considerable fine grit; and that the sand is decidedly gritty. Look closely to see if the individual soil particles are separate, that is, no two adhering to each other; or in clusters. Can you detect any difference in the odor of the different samples?

Put a handful of the loam soil into a glass jar or wide-mouthed bottle containing water and shake vigorously for two or three minutes. The coarse particles will settle first—the sand. Then the next finer—the silt, and lastly, the clay which will remain in suspension for several hours or days.

(Save for next exercise.)

Exercise No. 4.

EFFECT OF LIME ON CLAY SOIL.

Shake the jar containing the sample of loam until it is thoroughly mixed. Put about a spoonful of lime into it and shake for two or three minutes. Set aside and note results. What difference do you see in the way the different types of soil of which loam is composed settle? The lime causes the particles of clay to form into tiny clusters and then they settle more readily. Heavy clay soils are greatly improved by the addition of lime under field conditions. The principle is the same as that illustrated in this exercise. The clustering of the soil particles makes the soil more porous, which allows better aeration of the soil; allows the soil to warm up better, and allows the bacteria to work.

Exercise No. 5.

CAPACITY OF SOILS TO HOLD WATER.

Take equal samples by weight of dry sand, clay, loam and humus. Put one at a time on a plate and mix with it first enough water that it will crumble and fall apart when squeezed in the hand and then released. This is the proper condition for a soil to be in to be worked in the field or garden.

Which soil requires the most water to put it in proper condition to be worked?

If one hundred grams of each are taken, it will take about one hundred cubic centimeters of water for the humus; twenty-five to thirty for the clay; fifty to sixty for the loam, and about five to six for the sand.

Why the difference? Set away and note which dries out most readily. Why?

Exercise No. 6.

EFFECT OF WORKING SOILS WHEN TOO WET.

Take a sample of each; clay, loam, humus and sand as in the last experiment and add water gradually until each sample will hold no more, now set aside until they dry. How do they compare with the corresponding samples in experiment no. five when just the right amount of water was added? Which was injured the most by being worked when too wet which causes it to become hard and cloddy? More harm can be done by working heavy clay soils too early in the spring than can be remedied during the entire summer.

Exercise No. 7.

EFFECT OF FREEZING AND THAWING ON HEAVY SOILS.

Have the class spade up a plot of ground in the fall where it has been packed down or where it turns up in big chunks. Leave it rough until it begins to dry out in the spring. Have the class notice it occasionally to see the action of the freezing and thawing. This is

the best way to handle any heavy soil. Plow it in the fall and let it remain rough during the winter and then work it as soon as it will crumble up nicely in the spring. In most places it will be easy to point out fields that have been left rough by farmers and the same results can be noticed on a larger scale.

Exercise No. 8.

EFFECT OF HUMUS ON THE TEXTURE OF HEAVY SOILS.

Take a sample of heavy clay well pulverized, mix with it an equal volume of humus (well rotted organic matter). Fill one flower pot or tomato can with the clay and humus mixture, and a similar one with pure clay. Add water until it begins to drain through.

Which drains through first? Why? Which requires the most water to saturate it?

Set aside until drainage ceases. (Probably next day.)

Which soil works up the best after the surplus water has drained off?

This is one of the great benefits that the farmer derives by adding manure to his soil, or, in turning under stubble, etc. It is a decided waste to burn any kind of organic matter that can be plowed under and which will later form humus.

Exercise No. 9.

EFFECT OF HUMUS ON SANDY SOILS.

Take a four-inch flower pot or small tin can with perforated bottom and fill with a sandy soil. Fill a second one with a mixture of the sandy soil and humus, equal parts well mixed. Add water to each until drainage starts. Which begins to drain through first? Why? Which one requires the most water before becoming saturated? Why? In the last experiment we found that the water drained through first in the mixture of clay and humus, and that the mixture held the most moisture. In the case of the sand and humus we find that the water drained through first in the pure sand, but that the mixture of sand and humus retained the most water. In other words, the addition of humus benefits both types of soil. It makes the clay soil work much more easily, and it makes the sandy soil retain more moisture. Humus benefits any type of soil.

Exercise No. 10.

KINDS OF WATER IN SOIL.

Fill a flower pot with a sample of soil (loam preferable), add water until it begins to drain off. This water that drains off is called free water. It goes down through the soil the same as an apple falls to the ground—by gravity. After drainage ceases there is still a great deal of water left in the soil.

Spread the soil out in a plate or on a board and let dry in the room until it will get no drier. This will take two or three days or more. This water that was lost by being dried in the open air is called

capillary water, because it is held in the soil by capillarity or capillary attraction, which will be illustrated in the next exercise.

Now if we weigh this sample of air-dry soil, although it looks as dry as road dust, and heat it to the temperature of boiling water, 212 degrees Fahrenheit, for a few hours it will lose perhaps three per cent. to five per cent. of its weight due to the loss of water that was still clinging to the soil particles. This last form of water is called hygroscopic water. It is the capillary water from which plants get their supply.

Exercise No. 11.

EFFECT OF COLOR ON SOIL TEMPERATURE.

In the spring when the soil begins to warm up, select a bare plot of ground four feet square, divide it into two equal parts, cover one half of it with lime so the surface will be white. If the soil is a dark color the other half can be left as it is, if not, cover it with lamp black or powdered charcoal until it is black. Place a thermometer bulb down about two inches in the plot covered with lime, and note the temperature, then in the dark colored one and note the temperature. Which one warms up quickest? Why? The brighter the sun and the longer it shines on the plots the greater will be the difference. Is there any way that the farmer can change the color of his soil? By adding humus to the soil either by stable manure or green manure, the color is darkened.

Exercise No. 12.

HOW TO TELL IF A SOIL IS SOUR.

Buy some blue litmus paper at the drug store, dip a small piece of it into some vinegar or real sour milk. The blue paper changes to a red color. Any acid will cause it to do the same. Secure a sample of soil that you think might be "sour," (most swampy or marsh soils are apt to be sour). Have the sample of soil wet, when you test. Moisten the blue litmus paper and cover with the suspected sample of soil, let remain an hour or so (longer won't hurt). Note any change of color. If it turns red it is sour or acid.

By using red litmus paper and testing the soil in the same way it can be determined whether or not the soil is alkaline. If it turns the red litmus paper blue, the soil is alkaline.

Exercise No. 13.

HOW TO IMPROVE ACID SOILS.

Fill two six-inch flower pots or cans with the sour soil. Number them one and two. Thoroughly mix about two tablespoonfuls of lime in No. 1 and let stand a week or two keeping both pots equally moist. Now test them as before with the litmus paper. Place them in the window and plant ten kernels of corn in each pot and note results. Which one produces the best corn—the one that is still sour or the one that has been corrected? The addition of lime and thorough drain-

age are the best ways of correcting sour soils. Any poorly drained soil is apt to become sour. Sometimes, providing thorough drainage is all that is needed to correct the acidity.

Exercise No. 14.

CAPILLARY ACTION OF WATER IN SOILS.

Secure four small tin cans about six inches high and perforate the bottoms, or four lamp chimneys all the same size. (Preferably the chimneys because the class can see through them.) Tie a piece of cloth over the bottom of each one. Fill one with sand, one with clay, one with loam and one with humus. All the soils should be air dry. Set all four in a pan or other shallow vessel of water at the same time; add more water as it is taken up. Watch the water rise in them. Why does it come up? In which one does it rise the fastest? Why? This action is called capillary action. It is the same force that brings the oil up the lamp wick. There are tiny openings through the soil. The water adheres to the sides of these openings or the soil particles, then when the thin film of water gets around a soil particle, there is another force called "surface tension" that draws more water up to the upper part of the water tending to form a drop of water, but the same thing happens that started the water to rise, that is, the force that makes the water adhere or stick to the soil particles. This is how water comes up to feed the roots of plants.

Exercise No. 15.

WAYS IN WHICH WATER IS LOST—(1).

A large amount of water is lost from the soil by evaporation from the surface. After the soil begins to warm up in the spring call the attention of the class to the rapidity with which the surface soil dries out, especially when the wind is blowing or the sun is shining. Fill a shallow pan with water and set on the ground and see how long it takes it all to evaporate. It will surprise you. As water evaporates from the surface more water is drawn up by capillary attraction from the moist soil below. Capillary water always tends to move toward the driest soil. In this way large quantities of water are lost from the soil, perhaps as much as is really used by the growing crop.

A great deal of water is lost from the soil through the transpiration of water from the leaves of weeds. To demonstrate this, cut off any rank growing weed in the evening and cover with dry soil, notice before the sun dries it up in the morning. It will moisten sometimes as much as a quart of soil around it.

Exercise No. 16.

WAYS IN WHICH WATER IS LOST—(2).

There are four principal ways in which water is lost to the plant—run-off, under-drainage, by evaporation, and through weeds.

Have the class notice, after a heavy rain or while the snow is melting, how much of the water runs off down the hill slopes into the

valleys, into small streams, then into rivers and finally into the ocean. This water is not only lost, but carries with it a great deal of fertility from the soil. Collect a glass jar full of this run-off, let settle, note the sediment. How can this be prevented? Point out to the class fields that have been plowed and left rough, and fields that have been worked down smooth. Which allows the most run-off? Notice which allows the most run-off, a field that is filled with the roots of plants or one that has been cropped to one crop all the time and in which there are not so many roots.

When water reaches a depth of ten feet in the soil it is of very little, if any, use to plants. It is this free water that drains through the soil that furnishes our wells and springs.

Exercise No. 17.

THE SOIL MULCH.

In the last exercise we noticed that a large amount of water was lost by evaporation from the surface. Most of this can be prevented by the use of a dust mulch—that is by keeping the surface of the ground stirred up in a fine condition. This loose soil prevents the rise of capillary water, by leaving the soil particles so far apart that the rising water can not climb from one particle to the other.

Select a small plot of ground, say one square rod. Spade it all up carefully and work it down smoothly, pulverizing all the clods. Mark off one-half of it and keep the surface raked two or three inches deep once a week or after every rain (a rain tends to destroy the mulch), and leave the other one without working. Continue for three or four weeks or until you need the ground for other work. Note carefully which is in the best condition for planting after the experiment. Dig down into each to examine. Has either of them baked? Which is the driest? Why? This is why it is so essential for farmers to clutivate often, even when there are no weeds to be killed.

Exercise No. 18.

EFFECT OF ROLLING LAND.

Prepare a plot of ground as in example seventeen, divide into two equal parts. Pack one-half down as nearly the way it would be when rolled as you can, and leave the other half without treating. At the end of ten days or two weeks, note the difference. What effect did the rolling have on the tendency to bake or form a hard crust. It is seldom that the land should be rolled and left rolled. It should be harrowed to form a dust mulch after being rolled. Sometimes, however, it is advisable to roll it after planting very small seed so as to bring the moisture closer to the surface of the ground, but even then there is a sacrifice of water. This exercise could be worked in connection with the preceding one.

Exercise No. 19.

TILLAGE IMPLEMENTS.

Have each member of the class make a list of all the tillage implements used upon the farm, including plows, harrows, discs, weeders, cultivators, rollers, etc., and tell the purpose for which each is used and when each should be used.

Exercise No. 20.

WORKING OUT A SYSTEM OF CULTIVATION.

Have each member of the class ask their parents or some successful farmer their system of raising some particular crop. Select the crop that is most commonly grown in your locality, and have them work the system out in detail, giving the time of plowing, depth of plowing, harrowing and other preparation before planting the crop, preparation of the seed, rate of planting, that is, amount of seed per acre, depth of planting, and subsequent care of crop.

Exercise No. 21.

CROPS.

Have the class make a list of all the crops grown in the locality and estimate the yield per acre of each, and price of each. Which costs the most per acre to raise?

Make special study of the most important crops, including the selection of seed, preparation of seed, preparation of seed-bed, cultivation and care, harvesting, marketing or storing.

Exercise No. 22.

SELECTION OF SEED.

The rule should always be to select the best seed from the best plant. In the fall go into the wheat field and note the difference in the plants all grown under the same conditions of soil, climate, etc. Some are larger, have stooled, (branched), a great deal more, and are more vigorous than the rest of them. Select fifty of the best heads from the best plants and fifty average heads from average plants, and label each bunch carefully. Store them away for spring use. Have a row one rod long planted of each, side by side, and note the difference before school is out in the spring. This could be done either on the school ground or better have one of the pupils volunteer to do it at home, or as many as wanted to. This same exercise could be applied to potatoes, corn or any other crop.

If potatoes, the best hills are those that have the largest number of medium sized ones—not the hills with a few big ones and a lot of little ones or odd-sized ones. The same would apply to peas in the pod.

Exercise No. 23.

FORCE EXERTED BY THE SWELLING OF SEEDS.

Select a small, stout tin can with the top removed. Fill level full with wheat or any kinds of seeds which are alive and dry, and cover

with water. Lay a small, smooth block on top and place one or two bricks' weight on top to see how much weight the seeds will lift by the absorption of water. Weigh the weights that were used. Estimate how many times its own weight the seeds were able to lift. Why is is necessary for seeds to be able to exert so much force?

Exercise No. 24.

PROPER AMOUNT OF WATER FOR GERMINATION.

Secure three small tin cans or glass jars, number them one, two and three. Fill each with the same kind of soil. Soak eighteen beans or kernels of corn for twenty-four hours. Put six of them in each vessel of soil one inch deep. Leave can number one nearly dry; can number two just moist enough to work nicely, and keep number three covered with water. Notice every twenty-four hours till germination has ceased. Which ones germinate the best? What effect did the excess of water have? It was due to the fact that air was excluded and not to the presence of the water. This exercise shows just what happens when seeds are planted in poorly prepared land or when it is too wet or too dry. Keep the experiment going for at least two weeks. Which are the stronger plants?

Exercise No. 25.

DEPTH TO PLANT.

Select some large seeds such as corn, beans, or peas. Prepare enough soil to fill a glass jar or wide-mouthed bottle, preferably one about six inches deep. Put one inch of the soil which should be moist enough to insure germination, but not wet, and place one of the seeds on it against the side of the soil can so it can be easily seen. Add another inch of soil and another seed, placing the seed a little to the right or left of the one just below. Continue until the jar is filled. Keep moist and in a dark (warm) place. Notice every twenty-four hours. What depth seems to produce the strongest plant? Continue till all come up that will. Have the pupils ask their parents what depth they plant the seeds used in this exercise.

This exercise can be repeated using smaller seeds.

Exercise No. 26.

THE BEST TEMPERATURE FOR GERMINATION.

Select three lots of ten seeds, either of beans, corn, peas or wheat. Put each lot in a flower pot or tin can filled with soil in condition for best germination. Number them one, two and three. Set number one out doors when the weather is just about freezing, set number two on the floor close to a door or window, and number three in a warm room. If there is a thermometer convenient, have some of the boys find the temperature of each, and record. Continue until all have germinated. Save for next exercise. At what temperature did the seeds germinate best? What would this indicate as to time of planting seeds in the spring?

Exercise No. 27.

NUMBER OF TIMES SEED WILL GERMINATE.

Germinate some wheat or corn and when the sprouts are about one-half to one inch long let them dry out. When they have become dry repeat the process and see how many times you can get them to send out a new sprout. Let one or two grow from each test, compare with former germination. Quite often grain is planted in the fall after a rain, followed by continued dry weather, and the same results that we had in this exercise occur.

Exercise No. 28.

GERMINATION TEST OF SEEDS.

Take two plates of the same size, so one can be laid bottom side up over the other. Get two pieces of blotting paper or heavy cloth, and moisten. Count out one hundred seeds that are to be tested and place between the blotter or cloth, place between the plates and set in a warm place. Keep them moist but not wet. After they begin to germinate, count the ones that have germinated every twenty-four hours, until all have germinated that will. The higher the per cent. of germination the better the seeds. Weak seeds germinate slowly and show a lack of vigor, and a low percentage of germination. This is a sample test and should be in common use on the farm, not only for garden seeds but for field crops. Have the class figure the per cent of germination. Have them bring samples of different kinds of seed from home to be tested.

Exercise No. 29.

EFFECT OF LIGHT ON PLANTS.

After exercise number 28 is completed, set one of the pots or cans in a dark place and leave one of the others in the light. Keep them both watered the same, and the temperature as nearly the same as possible.

What effect has the light on the color of the plants? What change has taken place in the leaves of the plant? After the one in the dark has lost most of its color set it in the light beside the other one, and see what happens. When do plants grow the best, when the sun is shining or when it is cloudy, even though the temperature is the same in both cases?

Exercise No. 30.

WEEDS.

Have the class make a list of all the weeds of the locality, and classify them into annuals, biennials, and perennials. Tell where each is the most troublesome. Which class are the hardest to control? Why? It is well to have specimens of as many as possible brought to class by the pupils so each will learn to identify them. Any that the

class or teacher is unable to identify may be sent to the director of the Experiment Station, Pullman, Washington, and they will gladly identify them for you.

Exercise No. 31.

HOW WEED SEEDS ARE SCATTERED.

Have the class make lists of the common weeds of the locality and tell how they are scattered. They will find that some are scattered by the wind, such as the thistles, dandelions, milk weeds, etc.; some by animals, such as hoarhound, cocklebur, etc.; some by birds, as small seeds; some, by running water.

Exercise No. 32.

WEEDS NOT SCATTERED BY SEEDS.

Some of the worst weeds that we have are not scattered by seeds, although they have seeds. The Canadian thistle and the wild morning glory are among the worst. Any joint of the roots will produce a new plant. They are easily scattered when plowing or cultivating. If there are any in the neighborhood, have specimens brought to class so they may all become familiar with them. They may be killed by keeping them cut off and never allowing them to form any leaves, thus starving the roots.

Have some of the pupils volunteer to try this experiment on a small plot at home.

Exercise No. 33.

INSECTS.

Have the class make a list of all the insects that are troublesome in the gardens, orchards, or fields in the locality. Have them study the life history of the most important ones, and the best method of controlling them. (See "Spray Calendar," Washington Experiment Station, Pullman, Washington.) There are four stages in the life history of an insect: the egg stage, the larva, the pupa, and the adult. It is important to know in which stage they pass the winter, and when they are most active.

Select some common ones such as the tent caterpillar, the eggs of which will be found in bands around small twigs in the winter. They hatch out early in spring into caterpillars, and make their tents; they remain in the tent for three or four weeks, then crawl off to the ground or under the bark and hide, and go into the pupa stage; they remain here for some time, and then come out as an adult. The adult lays the eggs for the following year and dies, thus completing the life history.

Exercise No. 34.

PLANT DISEASES.

Have the class make a list of all the diseases that are injurious to the garden, orchard or field plants. Have them bring specimens whenever possible to the classroom. Any of them may be identified

by sending to the Experiment Station at Pullman, Washington, and the Spray Calendar will give directions for controlling all of them.

Exercise No. 35.

PREPARING THE LAND FOR GARDENS.

Whenever possible have an application of well rotted stable manure put on the ground to be used for the garden before plowing, whether in the fall or in the spring. In most cases it will be better to have the plowing done in the fall leaving it rough, that is, not working it after plowing.

Have it harrowed as soon in the spring as it is dry enough to work, and then harrow every week or often enough to keep from baking, until time to plant. This will put the soil in the best possible condition, and at the same time will start most of the seeds in the surface soil.

Exercise No. 36.

LAYING OUT THE SCHOOL GARDEN.

A plot of ground one rod square is a convenient size for each individual pupil, but if there isn't ground enough for all of them to have a square rod, two may work together or the size of the plot may be reduced to suit the conditions at hand.

There should be an alley on at least two sides of each plot and preferably on all four sides. The alleys, as a rule, should not be over two feet wide. It is sometimes better to have the main alleys three feet wide and the others two feet. Have the class stretch a line along one side and place a small stake at one end, then measure off one rod, place a stake, then mark off two feet for an alley, and continue the entire length of the line. Do the same on the opposite side. Mark off the ends in a similar manner, placing a stake at each corner of each plot. Have all the lines exactly straight, as it adds materially to the appearance of the gardens. Permanent stakes should be made two and one-half inches wide, three-fourths thick and eighteen inches long. They should be painted and pointed so they can be driven into the ground easily. Drive them all in uniformly deep. Write the pupil's name on one corner of the plot.

Exercise No. 37.

PLANTING AND CARE OF THE SCHOOL GARDENS.

If the school does not furnish hoes, rakes, etc., most of the pupils can bring them from home. It is best to let each pupil select the different vegetables or flowers for his own garden, the teacher advising with him to see that he selects only those which can be expected to do well under their conditions. It is best to select early maturing crops, such as lettuce, spinach, radishes, onion sets, and similar plants that they can get the benefit of before school is out, or else select crops that will require but little care through the summer. Have each pupil make a diagram of his plot indicating where the rows are to be and what is to be planted in each row. This will save a great deal

of time when they get into the garden. It will also teach them to have a system about their work. They should arrange their different varieties so they will interfere with each other as little as possible.

Rake thoroughly once each week or as often as it needs to be done.

Exercise No. 38.

HOW TO MAKE A HOTBED.

Make a frame of boards six feet wide, twelve feet long, or any desired length, one foot high in front and one and one-half feet high on the back side, brace with two by four material every three feet of length across from front to back. Drive two by four stakes securely into the ground at the corners having the tops of the stakes flush with the tops of the frame. Have the frame set level on the ground facing the south.

Dig out all the soil inside the frame to a depth of one and one-half feet and bank up around the outside of the frame with part of it. Make sash three feet by six feet and cover with glass or cheese cloth.

About a week before ready to use fill in about one and one-half feet deep with fresh horse manure which contains considerable straw or other bedding. Pack it down well by tramping constantly while putting in. Have some soil ready to put in that has considerable sand and humus mixed with it. Put in four to six inches of soil, put on the sash and allow it to heat. It will heat rather violently at first, but after about a week the temperature will remain about constant.

Exercise No. 39.

HOW TO USE THE HOTBED.

After the temperature has become constant it is ready to receive the seed. Any seed that needs to be started early and transplanted can be started successfully in the hotbed, such as cabbage, cauliflower, tomatoes and flowers such as pansies, asters, etc. If the class is large it will be best to mark the bed off into small plots and give each pupil or each two pupils a plot. If the class is small they may all work together. Let them start plants for their own garden and also for their parents and neighbors. Pupils always take a great deal of interest in the hotbed and the plants they grow in it.

Lettuce, spinach, etc., may be grown to maturity in the hotbed.

Always ventilate well or plants will get weak and spindling. Water only when necessary, frequently in the evening and never in the bright sunshine.

Exercise No. 40.

COLD FRAMES.

A cold frame is made first like a hotbed with the exception that it has no artificial heat. After the hotbed has exhausted itself, it is practically a cold frame and may be used as such.

Cold frames are used to harden plants that have been raised in the hotbed if they are not ready to plant out in the open, and for later

use in the spring. Sometimes they are used as protection from insects such as cabbage maggots, etc. Ordinarily plants raised in the hotbeds can be hardened off enough by leaving the bed open more as the plants get older.

Exercise No. 41.

HOW TO TRANSPLANT YOUNG PLANTS.

When your cabbage and other plants are six to eight inches high and have their true leaves, and the ground is ready, dig up the plants with a trowel leaving as much dirt on the roots as possible. Break off about half of the leaves and place the plants in a hole large enough to receive them with the roots in a natural position. Fill in with loose soil and press down firmly, then rake some loose dirt around to prevent evaporation. It will seldom be necessary to water the plants. It will be found better to transplant during cloudy weather, or just before a rain, or in the evening.

Exercise No. 42.

PROPAGATION OF PLANTS BY CUTTINGS—(1).

Make soft wood cuttings of Geranium, Coleus, Carnation or Begonia, by taking the ends of the new growth after the growth is fairly well matured. Place in sharp clean sand and water well, keep in moderate temperature and shade them. Try putting some of the same cuttings in a glass of water, change the water to keep fresh. After the roots have started well pot the cuttings in small flower pots in soil composed of about equal parts of well rotted humus, sand and loam. Have the class make a list of all the plants that are propagated from soft wood cuttings.

Exercise No. 43.

PROPAGATION OF PLANTS BY CUTTINGS—(2).

Make hard wood cuttings of currants, gooseberry, willow or rose, by taking sections about six inches long of the current year's growth. Stick them in the moist sand or soil in a cool place. Leave about one inch out of the soil. The leaves, when present, should be trimmed back to one or two to prevent transpiration.

Have the class make a list of the plants commonly propagated by hard wood cuttings. Notice where the roots start from. After the cuttings have been made three or four weeks, you will notice a "Callous" on the lower end. The roots will start from this.

Exercise No. 44.

PROPAGATION OF PLANTS BY BULBS.

Secure bulbs of tulips or other flowers and plant them in the fall and note how early they come up in the spring.

Make a list of all the plants you can that are propagated by bulbs. Secure as many different kinds as you can, and start them in the school room.

Exercise No. 45.

PROPAGATION OF PLANTS BY LAYERING.

Black raspberries, and sometimes gooseberries are propagated by layering. Take the class in the fall to a garden where there are some black raspberries. Lay some tops of long canes on the ground and cover with moist soil. They will take root by spring and the young plants can be cut loose from the old plant.

Have the class make a list of all the plants they can that are propagated by layering.

Exercise No. 46.

PROPAGATION OF PLANTS BY BUDDING.

Cherries, plums, peaches, and roses are propagated by budding. This can be done any time when the bark will slip or peel loose from the wood and when mature buds can be found. Some of the pupils can probably find small seedlings of one of the above plants. Select one about the size of a lead pencil, late in the summer or early in the fall. Select a thrifty well matured bud from a tree of the same kind that you wish to propagate, of the current year. Make a longitudinal cut just through the bark of the seedling about an inch above the ground, and another cut vertical to the first at the upper end, forming a "T." Now with the point of a sharp knife open up the cuts so the bud can be inserted. Cut the bud by cutting just into the wood under the bud and coming out about one-half inch below. Cut the leaf over the bud off but leave the stem to assist in inserting it into the opening. Now insert the bud into the opening and tie above and below with a soft twine string, but not over the bud. This can be done without taking up the seedling, but for demonstration, it will be best to bring it to the classroom. If the bud lives it will remain plump, but if it doesn't it will wilt and wither away in a week or two. In the spring the string should be removed.

Exercise No. 47.

HOW TO MAKE GRAFTING WAX.

Take four parts, by weight, of resin, two of beeswax, and one of tallow. Melt together over a slow fire. When all are thoroughly melted, pour into a bucket of cold water. Allow to get cool enough to handle, then pull like taffy, until it reaches a light glistening color.

The wax cloth or string may be made by dipping it into the melted wax and letting drain as much as it will.

The hands should be well greased to prevent the wax sticking to them.

For outside work the wax may be made by using equal parts of resin and beeswax and applying with a small brush while quite warm.

Why are trees grafted or budded? Why not use seedlings?

Exercise No. 48.

PROPAGATION OF PLANTS BY GRAFTING.

Apples and pears are commonly grafted. Have some of the pupils find an apple seedling about the size of a lead pencil and bring to class. Also have some one bring a small limb of a desirable variety of apples. It must be the current year's growth. The seedling will be the stock, but the other will be the scion.

With a sharp knife, cut the stock off just below the crown, making a slant about an inch long. Now cut the lower end of the scion with the same slant. Now place the knife about one-fourth of the way down from the end of the slant and cut straight down about three-fourths of an inch. Now slip them together. Be sure that one edge of the scion is in contact with one edge of the stock, otherwise they will not unite. It is the cambium layer that produces all the growth. Now cover with grafting wax or bind securely with wax cloth, or wax string.

Exercise No. 49.

HOW TO USE THE SCORE CARD.

Take the class to a nearby farm where there is a gentle cow. Have the class form a semicircle on one side of the cow. Point out and name all the different parts of the cow, beginning at the head and working back. They will learn very quickly the names of the various parts, which are named in the score card, and which may be found located on diagrams in nearly any elementary text book on agriculture.

After one or two lessons on naming the parts of the animal, go over her again and explain in detail how each part should be on an ideal cow. It is astonishing to see how quickly pupils of this age learn to pick out the best animals. After they have had a little experience in going over the animal, place two or three animals side by side and let the class pick out the best one.

The same method is to be followed in the judging of other farm animals.

SCORE CARD.

DAIRY CATTLE.

Scale of Points.	Standard.	Points Student's score.	Deficient. Corrected.
Head—8 Per Cent.			
1. Muzzle, broad	1	.....	.....
2. Jaw, strong, firmly joined	1	.....	.....
3. Face, medium length, clean	1	.....	.....
4. Forehead, broad between eyes, dishing	1	.....	.....
5. Eyes, large, full mild, bright	2	.....	.....
6. Ears, medium size, fine texture; secretions oily and abundant, yellow color	2	.....	.....
Forequarters—10 Per Cent.			
7. Throat, clean	1	.....	.....
8. Neck, long, spare, smoothly joined to shoulders, free from dewlap	2	.....	.....
9. Withers, narrow, sharp	3	.....	.....
10. Shoulders, sloping, smooth; brisket light	3	.....	.....
11. Fore legs, straight, clean, well set under body	1	.....	.....
Body—25 Per Cent.			
12. Crops, free from fleshiness	1	.....	.....
13. Chest, deep, roomy, floor broad	6	.....	.....
14. Back, straight, strong; vertebrae open	3	.....	.....
15. Ribs, long, deep, sprung, wide apart	3	.....	.....
16. Barrel, deep, long, capacious	10	.....	.....
17. Loin, broad, strong	2	.....	.....
Hindquarters—12 Per Cent.			
18. Hips, prominent, wide apart	1	.....	.....
19. Rump, long, level, not sloping	4	.....	.....
20. Pin Bones, wide apart	1	.....	.....
21. Tail, neatly set on, long, tapering	1	.....	.....
22. Thighs, spare, not fleshy	3	.....	.....
23. Hind Legs, well apart, giving ample room for udder	2	.....	.....
Mammary Development—30 Per Cent.			
24. Udder, large, very flexible, attached high behind carrying well forward; quarters even, not cut up	15	.....	.....
25. Teats, wide apart, uniformly placed, convenient size	5	.....	.....
26. Milk veins, large tortuous, extending well forward	4	.....	.....
27. Milk wells, large	6	.....	.....

SCORE CARD.

BEEF CATTLE.

Scale of Points.	Standard.	Points Deficient. Student's score.	Corrected.
General Appearance—40 Per Cent.			
1. Weight, estimated ..... lbs. Actual ..... lbs. according to age	10	.....	.....
2. Form, straight top and underline; deep broad, low set, stylish, smooth, compact, symmetrical	10	.....	.....
3. Quality, fine, soft hair; loose, pliable skin of medium thickness; dense, clean, medium sized bone	8	.....	.....
4. Condition, deep, even covering of firm mellow flesh; free from patches, ties, lumps and rolls; full cod and flank indicating finish	12	.....	.....
Head and Neck—7 Per Cent.			
5. Muzzle, broad, mouth large; nostrils large and open	1	.....	.....
6. Eyes, large, clear, placid	1	.....	.....
7. Face, short, jaw strong	1	.....	.....
8. Forehead, broad, full	1	.....	.....
9. Ears, medium size, fine texture	1	.....	.....
10. Neck, short, thick, blending smoothly with shoulder; throat clean with light dewlap	2	.....	.....
Forequarters—9 Per Cent.			
11. Shoulder vein, full	1	.....	.....
12. Shoulders, smoothly covered, compact, snug, neat	4	.....	.....
13. Brisket, trim, neat; breast, full	2	.....	.....
14. Legs, wide apart, straight, short; arm full; shank fine	2	.....	.....
Body—30 Per Cent.			
15. Chest, full, deep, wide; girth, large; crops, full	4	.....	.....
16. Ribs, long, arched, thickly and smoothly fleshed	8	.....	.....
17. Back, broad, straight, thickly and smoothly fleshed	8	.....	.....
18. Loin, thick, broad	8	.....	.....
19. Flank, full even with underline	2	.....	.....
Hindquarters—14 Per Cent.			
20. Hips, smooth	1	.....	.....
21. Rump, long, wide, level; tail-head smooth; pin-bones wide apart, not prominent	3	.....	.....
22. Thighs, deep, full	4	.....	.....
23. Twist, deep, plump	4	.....	.....
24. Legs, wide apart, straight, short; shanks fine, smooth	2	.....	.....
Total	100	.....	.....

SCORE CARD.

DRAFT HORSES.

Scale of Points.	Standard.	Points Deficient. Student's score.	Corrected.
General Appearance— Per Cent.			
1. Height, estimated .... hands; actual .... hands		.....	.....
2. Weight, over 1,600 lbs., estimated....lbs.. actual .... lbs., according to age....	6	.....	.....
3. Form, broad, massive, well proportioned, blocky, symmetrical	4	.....	.....
4. Quality, refined; bone clean, hard, large, strong; tendons clean, defined; skin and hair fine; feather, if present, silky	6	.....	.....
5. Temperament, energetic; disposition good.	3	.....	.....
Head and Neck—9 Per Cent.			
6. Head, lean, proportionate size; profile straight	1	.....	.....
7. Ears, medium size, well carried, alert....	1	.....	.....
8. Forehead, broad, full	1	.....	.....
9. Eyes, full, bright, clear, same color.....	2	.....	.....
10. Lower jaw, angles wide, clean	1	.....	.....
11. Muzzle, neat; nostrils large, open, free from discharge; lips thin, even, firm..	1	.....	.....
12. Neck, well muscled, arched; throatlatch clean; windpipe large	2	.....	.....
Forequarters—24 Per Cent.			
13. Shoulders, moderately sloping, smooth, snug, extending into back	3	.....	.....
14. Arm, short, strongly muscled, thrown back, well set	1	.....	.....
15. Forearm, strongly muscled, wide, clean...	2	.....	.....
16. Knees, deep, straight, wide, strongly supported	2	.....	.....
17. Cannons, short, wide, clean; tendons defined, set back	2	.....	.....
18. Fetlocks, wide, straight, strong, clean....	1	.....	.....
19. Pasterns, moderate length, sloping, strong, clean	2	.....	.....
20. Feet, large, even size, sound; horn dense, waxy; sole concave; bars strong; frog large, elastic; heel wide and one-fourth to one-half the lineal length of toe	8	.....	.....
21. Legs, viewed in front, a perpendicular line from the point of the shoulder should fall upon the center of the knee, cannon, pastern and foot. From the side, a perpendicular line dropping from the center of the elbow joint, should fall upon the center of the knee and pastern joints and back of the hoof	3	.....	.....
Body—9 Per Cent.			
22. Chest, deep, wide, large girth	2	.....	.....
23. Ribs, long, well sprung, close; coupling strong	2	.....	.....
24. Back, straight, broad, strongly muscled...	2	.....	.....
25. Loins, wide, short, thickly muscled.....	2	.....	.....

SCORE CARD.

DRAFT HORSES—(Cont.)

	Scale of Points.	Standard.	Points Deficient. Student's score.	Corrected.
26.	Underline, low; flanks full	1	.....	.....
Hindquarters—30 Per Cent.				
27.	Hips, broad, smooth, level, well muscled.	2	.....	.....
28.	Croup, not markedly drooping, wide, heavily muscled	2	.....	.....
29.	Tail, stylishly set and carried	1	.....	.....
30.	Quarters, deep, broad, heavily muscled, thighs strong	3	.....	.....
31.	Gaskins, long, wide, heavily muscled	2	.....	.....
32.	Hocks, large, clean, strong, wide, well set	6	.....	.....
33.	Cannons, short, wide, clean; tendons defined	2	.....	.....
34.	Fetlocks, wide, straight, strong, clean	1	.....	.....
35.	Pasterns, moderately sloping, strong, clean	2	.....	.....
36.	Feet, large even size, sound; horn dense, waxy; sole, concave; bars, strong; frog, large, elastic; heel wide, and one-fourth to one-half the lineal length of the toe	6	.....	.....
37.	Legs, viewed from behind, a perpendicular line from the point of the buttock should fall upon the center of the hock, cannon, pastern and foot. From side, a perpendicular line from the hip joint should fall upon the center of the foot and divide the gaskin in the middle, and a perpendicular line from the point of the buttock should run parallel with the line of the cannon	3	.....	.....
Action—9 Per Cent.				
38.	Walk, fast, elastic, regular, straight	6	.....	.....
39.	Trot, free, springy, balanced, straight	3	.....	.....
	Total	100	.....	.....

SCORE CARD.

MUTTON SHEEP.

	Scale of Points.	Standard.	Points Deficient. Student's score.	Corrected.
1.	Age	..	.....	.....
	General Appearance—38 Per Cent.			
2.	Weight, score according to age	8	.....	.....
3.	Form, long, level, deep, broad, low set, stylish	10	.....	.....
4.	Quality, clean bone; silky hair; fine, pink skin; light in offal, yielding high percentage of meat	10	.....	.....
5.	Condition, deep even covering of firm flesh, especially in regions of valuable cuts. Points indicating ripeness are, thick dock, back thickly covered with flesh, thick neck, full purse, full flank, plump breast	10	.....	.....
	Head and Neck—7 Per Cent.			
6.	Muzzle, fine; mouth, large; lips, thin; nostrils large and open	1	.....	.....
7.	Eyes, large, clear, placid	1	.....	.....
8.	Face, short; features, clean-cut	1	.....	.....
9.	Forehead, broad, full	1	.....	.....
10.	Ears, fine, alert	1	.....	.....
11.	Neck, thick, short, free from folds	2	.....	.....
	Forequarters—7 Per Cent.			
12.	Shoulders, covered with flesh, compact on top, snug	5	.....	.....
13.	Brisket, neat, proportionate; breast, wide	1	.....	.....
14.	Legs, straight, short, wide apart, strong; forearm, full; skin, smooth, fine	1	.....	.....
	Body—20 Per Cent.			
15.	Chest, wide, deep, full	4	.....	.....
16.	Ribs, well sprung, long, close	4	.....	.....
17.	Back, broad, straight, long, thickly fleshed	6	.....	.....
18.	Loin, thick, broad, long	6	.....	.....
	Hindquarters—16 Per Cent.			
19.	Hips, far apart, level, smooth	2	.....	.....
20.	Rump, long, level, wide to tail-head	4	.....	.....
21.	Twist, plump, deep	5	.....	.....
22.	Thighs, full, deep wide	4	.....	.....
23.	Legs, straight, short, strong; shank fine, smooth	1	.....	.....
	Wool—12 Per Cent.			
24.	Quantity, long, dense, even	4	.....	.....
25.	Quality, fine, pure; crimp close, regular, even	4	.....	.....
26.	Condition, bright, sound, clean, soft, light	4	.....	.....
	Total	100	.....	.....

SCORE CARD.

LARD HOGS.

	Scale of Points.	Standard.	Points Student's score.	Deficient. Corrected.
General Appearance—30 Per Cent.				
1.	Weight, score according to age	4	.....	.....
2.	Form, deep, broad, medium length; smooth, compact, symmetrical; standing squarely on medium short legs	10	.....	.....
3.	Quality, hair smooth and fine; bone medium size, clean, strong; general appearance smooth and refined	6	.....	.....
4.	Covering, finished; deep, even, mellow, free from lumps and wrinkles	10	.....	.....
Head and Neck—8 Per Cent.				
5.	Snout, medium length, not coarse	1	.....	.....
6.	Eyes, not sunken, clear not obscured by wrinkles	1	.....	.....
7.	Face, short; cheeks, full	1	.....	.....
8.	Ears, fine, medium size, attached neatly	1	.....	.....
9.	Jowl, full, firm, neat	2	.....	.....
10.	Neck, thick, short, smooth to shoulder	2	.....	.....
Forequarters—12 Per Cent.				
11.	Shoulders, broad, deep, smooth, compact on top	8	.....	.....
12.	Breast, full, smooth, neat	2	.....	.....
13.	Legs, straight, short, strong; bone clean, hard; pasterns short, strong, upright; feet medium size	2	.....	.....
Body—33 Per Cent.				
14.	Chest, deep, wide, large girth	4	.....	.....
15.	Sides, deep, full, smooth, medium length	8	.....	.....
16.	Back, broad, strongly arched, thickly and evenly covered	9	.....	.....
17.	Loin, wide, thick, strong	9	.....	.....
18.	Belly, straight, smooth, firm	3	.....	.....
Hindquarters—17 Per Cent.				
19.	Hips, wide apart, smooth	3	.....	.....
20.	Rump, long, level, wide, evenly fleshed	3	.....	.....
21.	Ham, heavily fleshed, full, firm, deep, wide	9	.....	.....
22.	Legs, straight, short, strong; bone clean, hard; pasterns short, strong, upright; feet medium sized	2	.....	.....
	Total	100	.....	.....

ADDITIONAL EXERCISES.